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ABSTRACT

Described are many concrete readiness activities within ten broad categories that are designed to provide children with a solid foundation for mathematics and that help prevent learning difficulties in mathematics. Preschool mathematical experiences form the foundation for all studies in mathematics. Without a sufficient number of appropriate mathematical experiences at this early stage in a child's develcpment, he/she will encounter needless learning difficulties in the future. Five major criteria are listed in the form of questions for selecting math activities: (1) Are the activities appropriate for each child's developmental level: (2) Will each child enjoy the activities and consider them fun: (3) Will each child successfully complete the activities: (4) Are the activities on a concrete level involving manipulative aids and/or diagrams and (5) Are the activities relevant to the child's environment? The mathematical experiences are divided into the following categories: patterns, sequences, classification (sets), one-to-one correspondence, conservation, numberness, matching, counting, shapes, and vocabulary. (MP)

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A PRESCHOOL PROGRAM FOR PREVENTING LEARNING DIFFICULTIES IN ARITHMETIC

by William P. Dunlap

Many studies have demonstrated the great impact the first six years of life have on the total development of a child. One area in which educators and parents can help to assure the child's maximum development is in the field of mathematics. Early mathematical experiences form the foundation for all later studies in mathematics. Without a sufficient number of appropriate mathematical experiences at this early stage in the child's development, he will encounter needless learning difficulties in the future. Care must be taken that these mathematical experiences are carefully planned, as the experiences that do randomly occur are, more often than not, inaporopriate and/or meaningless to the child and thereby result in confusion and frustration. A negative attitude towards mathematics will naturally arise from inappropriate activities.

Mathematical experiences must be very concrete and appropriate for the child's developmental level. Educators have a tendency to rapidly rush mathematical experiences from the concrete level to the abstract level. Young children are pushed to count, to write numerals, to add, etc. These abstract activities actually do the child more harm than good if the child has not experienced many concrete readiness activities involving maripulative aids and pictures prior to working with symbols.

In addition to concrete math experiences, children need to have fun as they study math. They must be successful with the activities as enjoyment is enhanced by success not by frustration and failure.

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Criteria and Categories

The major criteria used in selecting math activities may be presented in the form of questions. These questions should be referred to when selecting any activity for young children:

1) Are the activities appropriate for each child's developmental level?

2) Will each child enjoy the activities and consider them fun?

3) Will each child successfully complete the activities?

4) Are the activities on a concrete level involving manipulative aids and/or diagrams?

5) Are the activities relevant to the child's environment?

If you are able to answer "yes" to these five questions then you are very likely selecting an activity that is truly appropriate for that child.

Mathematical experiences for young children should be in one of the following ten categories.

A) Patterns
B) Sequences
C) Classification (Sets)
D) 1-1 Correspondence
E) Conservation
F) Numberness
G) Matching
H) Counting
I) Shapes
J) Vocabulary

Patterns

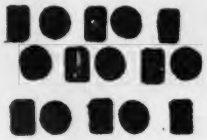
Activities in the pattern category require children to manipulate objects - copying and/or continuing a given pattern. The child may be given a card showing a red-white-red block pattern or the blocks themselves

arranged accordingly. The child is expected to take three dimensional blocks and copy and/or continue the pattern. This type of activity could be done by using spoons and cups, beads, strips of materials, etc.... These types of activities can be varied by the number of pattern cards the child uses, whether he builds on or off the pattern card, the configuration of the pattern to be copied, the number of different colors or shapes in the pattern, etc. In the beginning the patterns would be linear and then as the child became more competent the patterns may be arranged in semicircular or circular form.

The patterns increase in difficulty according to the following sequence:

1) One straight line

2) Two straight lines

3) Three straight lines 

4) Semicircle

5) Circle

The children should do each of the patterns using materials that are the same shape, same color, or same objects. Afterwards, children copy the patterns using two shapes, two colors or two different objects. Other variations of this activity may utilize three colors, three shapes, three different objects.

Children should first copy the pattern by placing materials on the cards, then copy the pattern by placing the materials on the table beside the pattern card. Ultimately the child should look at the pattern card and visually implant the pattern in memory. Then the child should turn the pattern card over and copy the pattern from memory. This activity helps the child to develop and/or improve his visual memory. Activities should be planned and utilized to help children develop good visual memories.

Children must learn to recognize and to visually implant a pattern in memory if they are to succeed in mathematics. Patterns are repeatedly utilized to illustrate mathematical principles, such as commutative property, addition and subtraction as inverse operations, multiplication operation, division operation, etc. A good visual memory will help children to mentally perform operations on numbers and quantities. For instance, regrouping is more readily understood by children who can mentally visualize the change in grouping from hundreds to tens, tens to ones and vice versa.

Sequence

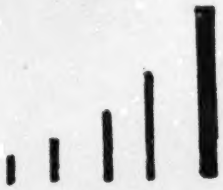
Experiences in the sequence category could take place during story time. As a story is read to the child, he should arrange appropriate

pictures depicting the events of the story. Care must be taken that the child is not initially overwhelmed with too many pictures. If the child does not fully understand what he is expected to do or is forced to interpret detail beyond his developmental level, he will become frustrated.

Cuisenaire rods may be used for activities in the sequencing category. For example, the child may arrange three rods in order from smallest to largest. In the beginning the differences in the lengths of the rods should be great; but after several experiences the differences can be lessened.

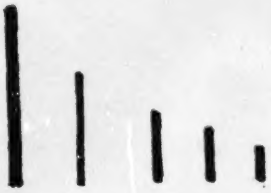
When planning activities in sequencing materials, children should first complete activities requiring them to start with the smallest object and proceed to the largest object.

Stage 1



Afterwards, the children should complete sequencing activities which requires them to go in reverse order -- from largest to smallest.

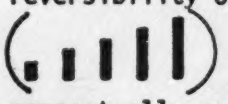
Stage 2



Many children may have difficulties with these activities as they are unable to reverse the thought processes. The activities will help to make their thought processes more flexible.

The third stage involves activities in which children start with the smallest object, proceed to the largest object, and then proceed to the smallest object.

Stage 3

This activity is even more difficult for children, who do not possess reversibility of thought process. Since the first portion of the pattern  remains in the child's view and since he is probably perceptually oriented, he has even more difficulty reversing his thought processes which are necessary to complete the sequence.

Sequencing is a fundamental mathematical activity and one which children should have many opportunities to practice. Sequencing objects is important readiness work for sequencing numbers. Reverse sequencing is also important and necessary to understand numbers.

Classification

Children need many experiences with sorting and classifing objects, as this is the first real experience they have with forming sets. They should form sets and describe them, sort objects into smaller sets, state the characteristics of sets, etc. These activities can range from sorting animals that live on land versus those who live in water to where products may be found in the grocery store or departments in a dimestore. One experience which lends well to the concept of set development is the sorting of several objects on the the floor or on a table. The objects should have many points of

comparison involving color, shape, length, thickness, etc. The child should sort them into "families" and relate what they have in common. Next, the child should sort the same objects in another way relating which point of comparison has changed. It is very important that the child develops an awareness of similarities and differences in objects. Naturally these activities should begin with obvious differences. There are many commercially prepared cards which have been designed for this purpose; however, it would be very simple to make picture cards such as the following:

The child would sort several of the cards into two stacks. One stack would show cards with the same pictures on the card and the other stack would represent cards with different pictures on them. From this point, the child can progress to finer discrimination activities.

One-To-One Correspondence

One-to-one correspondence is the basis for understanding numbers, and, as a result, children must readily learn and apply this skill prior to working with numbers. Once the child is able to form sets, he needs to form a 1-1 correspondence between sets having the same number of objects in each set and between sets having different quantities in the two sets. It is through the understanding of 1-1 correspondence that the child develops the concepts of equal, greater than, and less than. Once these concepts are developed the child is in a better position to understand the sequence of numbers. One example of this

type of activity could involve a guessing game. Given several spoons or cups, the child guesses whether there are more spoons or cups. The child then proceeds to put one spoon in every cup. Comparisons may be made between buttons and buttonholes, socks and shoes, plastic bottles and lids, fingers and rings, etc.

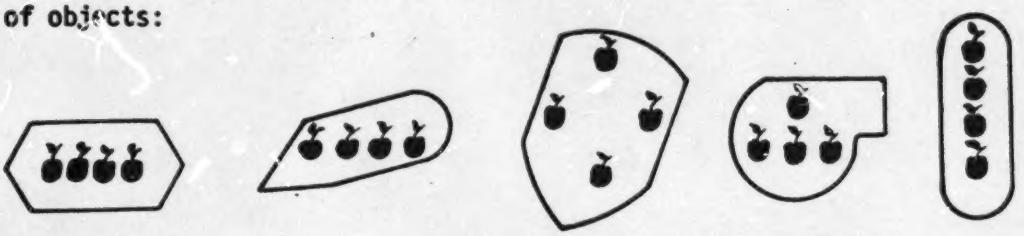
When planning activities involving 1-1 correspondence, one should ask children to first form 1-1 correspondence between equivalent sets and then the 1-1 correspondence between sets which are not equivalent. With each type of comparison, two types of sets should be used: 1) objects that naturally go together such as balls and bats and 2) objects that do not naturally go together such as apples and socks.

After performing several activities involving 1-1 correspondence between equivalent sets, children will readily develop the concept, "the same as," which is the foundation for "equals". If beginning activities with non-equivalent set emphasizes the concept, "more than", then several children may have difficulties with activities that emphasize the concept, "less than." The changing from "more than" to "less than" or vice versa requires children to reverse their thought processes. Children, who do not have reversibility, will not be able to readily switch from one concept to the other concept nor will they really understand the relationship between "less than" and "more than." Children, in the beginning, will view the two concepts as being separate and distinct. Later they will realize the relationship between the two concepts.

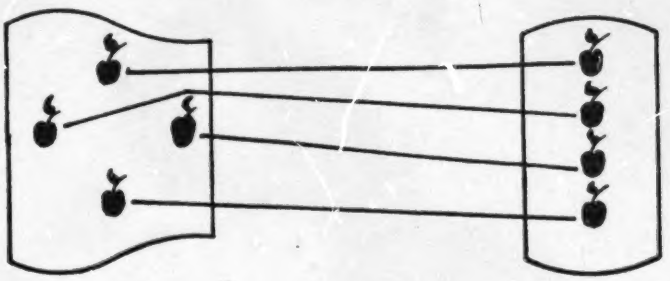
Conservation

Conservation is an important aspect of the developmental level

for children under six. Until children develop conservation of numbers they are not able to completely understand cardinal numbers. Conservation of numbers refers to the fact that the configuration of the set does not affect the quantity in the set. For example, children need to understand that each of the following sets contain the same number of objects:



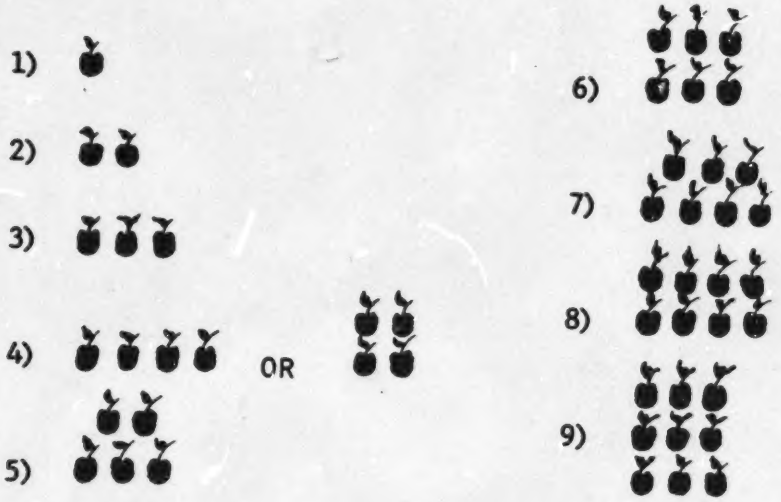
Children must use one to one correspondence to make sure that eacn set contains the same number of objects. The children may physically or mentally move the objects to compare the sets or draw lines from each object in one set to each object in another set as follows:



Numberness

After having worked with the previous five categories, the children are ready to study the cardinal numbers 1-9. All of the previous skills will be used to teach these numbers.

First, elemental groups should be used to represent each numeral as follows:



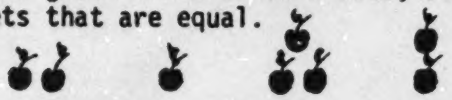
Please note the pictorial representation of each numeral will greatly aid the children in developing and retaining a mental image of each number.

Matching

The matching category experiences are very important. As with all the other categories, the activities should be very easy in the beginning and gradually become more difficult. Moreover, these activities should involve manipulative aids and diagrams. The children should work with concrete objects and pictorial representation of objects and numbers. They should work with each of the following types of exercises:

A) Matching Sets

At this point the children should have experience with creating a set to match a given set, demonstrating the concept of equals. Now they should, when given three or more sets, select the two sets that are equal.



B) Matching Shapes

The children have worked with matching objects but not geometric shapes. They should be able to match a given shape to one of three or more shapes.

C) Matching Numerals and Sets

This type of exercise lends itself to vast adaptation. Children should begin by matching one numeral to one set. For example, the children should have cards numbered 1-9 respectively. On these cards they may place buttons, clay balls, crayons, or any other such object to represent the given numeral. Later the children could work with many such activities until they are able to select a set containing a specified number of objects from two or more picture sets where only one set has the specified number of objects and the other sets contain different quantities.

Counting

Now children are ready to count. If children are taught to count before successfully completing the previous seven categories of activities, their understanding and mental images of the cardinal numbers (0-9) will be diminished. For example, consider the set : When children count this set prior to having a mental image of "4", they often develop a misconception, namely, that "4" is associated with the last object ----

They do not realize the "4" represents the total number of objects in the set. Thus, after children successfully complete the previously identified seven categories, they will have a mental image of the cardinal numbers (0-9) and will be ready to count with the desired understanding -- the cardinal number specifies the total number of objects in the set.

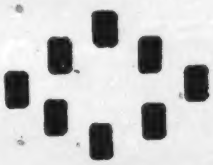
Children progress through at least five stages in counting. Activities should correspond to these stages and levels of difficulty.

Stage 1: Arrange objects in one straight line and count

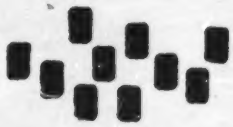
Stage 2: Arrange objects in two straight lines and count

Stage 3: Arrange objects in a semi-circle and count

Stage 4: Arrange objects in a circle



Stage 5: Arrange objects in a random order



At each stage the child should first place his finger on each object as he says the number and, then, second count the objects without using his finger. These two things should be done for each stage prior to moving to the next stage.

Shapes

Children enjoy working with shapes. They have had more experiences handling various shapes and experiencing their attributes than any of the other categories we have discussed, and as a result, they will probably be more successful with this category. The four basic shapes to be studied are square, triangle, circle, rectangle. (Caution: Do NOT teach that every square is a rectangle but not every rectangle is a square). Treat a square and a rectangle as two separate basic shapes. For all four shapes, first start with three dimensional models and then move to pictures for each shape, letting the children identify the shapes first by description, then by name.

Children go through stages in their ability to consider geometric ideas. We, as adults, may not remember the fact that understanding space is not just a perceptual activity. For example, teaching the concept of a triangle by the "show and tell" method does not at all insure that the child can represent mentally the idea of a triangle and, hence, understand it. Perceptual activities are the starting point but are not sufficient. Mental coordination actions of these sensory impressions must take place. These actions must often be based on physical or motor action such as tracing and retracting the figure with one's fingers.

The task of picking a geometric shape from a collection of shapes that the child has handled but not seen is less difficult than having to represent or draw the figure. Children should also have activities in representing figures by drawing them when they are able. If motor coordination is poor, the child may be asked to make the figure with matchsticks.

Vocabulary

The last category is understandably one of the most important for it is through concept and subsequent vocabulary development that we are able to communicate. Through conversation and example, children should learn the following concepts:

more	less	next to	many
top	away from	row	end
through	inside	different	behind
some	middle	same	right
few	between	after	outside
farthest	whole	almost	above
largest	nearest	alike	below
most	several	never	beside
beginning	other	every	left
matches	always	smallest	right
none	equal	near	
over	under	before	
far	next	all	

These words are used frequently to explain mathematical concepts so it is important that children are very familiar with their meanings

in order that they may understand the concept being taught.

Summary

Mathematics in an integral part of the young child's life. Mathematics is all around us, when we set the table, go to the grocery, pump gas into the car, play with blocks, anywhere and everywhere. Children go to school with many preconceived ideas and experiences in mathematics. Whether these ideas and experiences enhance or hinder the child's future development is up to those around him during his pre-school years. If children are able to carefully work through the categories mentioned, understand the concepts involved in each category and experience mathematics in a positive manner, they will be successful in the mathematics taught from grade one through eight.